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FOOD and CONTAINER PROBLEMS of the ARMED FORCES

QM

Brief statements of problems that the QM Food and Container Institute needs to solve in designing foods and containers adapted to the conditions of military handling, storage and use. To their solution the food and container industries, universities, foundations, Government laboratories and similar groups are invited to contribute.

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Foreword

Four revisions of this booklet, **Food and Container Problems of the Armed Forces,** have now been made. Key problems standing in the way of the development of operational rations have not only been presented in booklet form but have also been brought to the attention of those who can be of aid in solving them through various other means—through the medium of industrial journals, at meetings with representatives of industry, the universities, foundations, or the Armed Forces, and at various meetings of the Associates. It is our desire to project our basic problems before all groups, large or small, who can be of assistance in solving food and container problems peculiar to the Armed Forces.

Both major and minor progress has been made in solving the key problems projected in earlier issues of this booklet. The fact that many problems continue to be stated in the present booklet is explained by the fact that despite the progress made to date, the ultimate solution has not been reached. These are in many cases "long-term" problems.

The current status of each of our various research and development tasks is to be found in our technical progress reports to the Research and Development Division, Office of The Quartermaster General. Progress made in solving or alleviating the food and container problems of the Armed Forces can, therefore, be found in the yearly summary issued by this Division.

Many new problems appear in this revised edition of the problems statements. The attention of institutional members with interests in nutrition, food acceptance, and stability is invited to the concluding section of the booklet.

In stating our problems as explicitly and intelligibly as it is possible to do within the space limits established, we are seeking to answer a question that is perhaps in the minds of many technical people; namely, what problems exist for the Armed Forces that are different in nature or degree from those encountered in commercial production, distribution, and consumption?

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Animal Products Problems

Canned Products

Introduction

Work has been conducted during the year on canned meat items of borderline acceptability to raise their acceptance, principally with regard to taste, texture, and general appearance. Listed below are canned meat items which have been improved in acceptability and the changes responsible therefor:

ITEMS	CHANGES
Chicken and Vegetables	Formula completely revised
Corned Beef Hash	Raw packing specified
Pork and Apple Sauce	Sugar content reduced
Vienna Sausage	Beef content increased
Frankfurters	Beef content increased
Ham and Lima Beans	Ham content increased
Meat and Noodles	Meat content increased
Pork and Gravy	Fat and moisture content reduced
Beef and Gravy	Fat and moisture content reduced
Pork Sausage Patties	Salt content reduced
Hamburgers and Gravy	Fat test specified

Experiments to test the feasibility of preparing a skinless pork sausage link product proved successful, and a skinless pork sausage is now part of the Pork Sausage specification. Investigation of the use of black pepper flavoring in all canned meats demonstrated that the items prepared with black pepper flavoring were comparable to those prepared with ground pepper. Studies were conducted to check the acceptability of Vienna Sausages and Frankfurters (both products are types of Sausage, Beef and Pork, in Water, Canned.) Requirements in former specification permitted greater latitude—beef in proportions of 70-30%; pork 30-60%. The two improved products are made from the same raw ingredients, using the same formula, now specified as 75 percent beef and 25 percent pork, which has improved the texture and flavor greatly. The basic difference between the two products is that Vienna Sausages have square cut ends and Frankfurters have rounded ends, the result of linking. Because of the rounded ends, less meat goes into he same size can, and water circulation is more rapid during processing of the Frankfurters. It was found that for the same ize can (4-1/16 inches diameter x 4-11/16 inches high) the Frankfurters required less heat processing and as a result texture was improved. Recommendations have been made to keep the procurement of Vienna Sausages at a minimum. Thirteen canned meat specifications have been revised to reflect laboratory findings as well as the comments and suggestions of the various Governmental and Defense Department agencies and industry. The result of these studies and suggestions has been to increase the acceptability, stability, and utility of the products.

Of promise as added canned meat items are the following items submitted by industry. They were recommended on the basis of evaluation tests for further investigation:

Ham and Gravy
Ham and Potatoes w/Gravy
Ravioli w/Sauce
Chili Mac
Spiced Beef
Salisbury Steak w/Mushroom Gravy
Chopped Ham
Sliced Barbecued Pork
Spanish Rice w/Meat
Beef and Gravy w/Peas
Ham and Corn
Sausage and Corn
Thuringer Sausage

In addition, developmental work in the Institute has resulted in the following six items: Beef Steak and Potatoes with Gravy; Chicken and Noodles; Chicken, Boned, and Gravy; Chop Suey; Ham and Beans in Molasses Sauce; and Meat and Macaroni with Cheese Sauce.

Information applicable to improving canned meats has been obtained through a survey of the effect of thermal processing on normal commercial production of canned meat. Basic data have been accumulated which can be utilized in considering possible reductions in the amount of heat treatment necessary to accomplish stability in canned animal products for Armed Forces rations use. Reductions in heat treatment, consistent with product stability, are desirable to improve the quality of canned animal products. Seven plants were surveyed in Illinois, Indiana, Iowa, Kansas, Minnesota, South Dakota, and Wisconsin.

CANNED MEATS (A)

PROBLEM. Improvement of marginally acceptable, and development of acceptable canned meat items with a storage life of at least 1 year at 100° F.

PRESENT SITUATION. One hundred canned meat items are required possessing distinctly different flavor, texture, and appearance characteristics; 20 of these items are required for breakfast use. Canned meat items used by the Armed Forces fall into 11 general groups: (1) stews, (2) meat and gravy, (3) highly seasoned items, (4) patties, (5) meat and fruit, (6) meat and cereals, (7) meat and eggs, (8) spreads, (9) luncheon meat, (10) steaks and (11) specialties such as chop suey and pork tongue. Within these groupings approximately 35 items are now available (of the 100 desired) that are sufficiently different to offer variety.

In an accelerated developmental program undertaken by the Institute in cooperation with the canned meat industry, products from industrial sources are being screened by Institute technologists and the Military. Evaluation is on the basis of color, odor, general appearance, texture, flavor, and military characteristics. If a product passes the screening test, it is subjected to acceptance testing. If the product rates high on the acceptance scale, the manufacturer is requested to supply information required in preparing a specification. In cooperation with members of the canned meat industry the following canned meat items have been examined and evaluated:

Sliced Beef and Gravy*
Sliced Pork and Gravy
Barbecued Chicken
Georgia Stew
Georgia Hash
Whole Chicken*
Turkey and Vegetables
Beans and Ham
Turkey Loaf*
Beef Stew*
Horse Meat w/Onions and Cabbage
Chili and Franks*
Veal Chops
Boned Turkey
Pan Fried Beef
Kippered Beef
Hamburger (w/25% meat extender)
Ham and Gravy
Ham and Potatoes with Gravy
Pattie Franks
Ravioli with Sauce*
Smoked Sliced Turkey
Chili Mac
Smoked Turkey Pate
Smoked Whole Shrimp
Ham and Corn
Spiced Beef
Skinless Pork Sausages*
Liquid Meal (homogenized) (Meat and Vegetable Juices)
Whole Roasted Chicken
Meat Balls and Pea Beans
Meat Balls and Lima Beans
Sausage Balls and Pea Beans
Sausage Balls and Lima Beans
Chopped Ham
Pork Sausage Patties w/Apple Slices
Beef Luncheon Meat
Sliced Barbecued Pork
Spanish Rice w/Meat*
Beef and Gravy w/Peas
Chicken Stew
Beef Broth
Swiss Steak
Hamburger in a Bun
Frankfurter in a Bun
Sausage and Corn
Meat and Bacon Loaf
Oxtail Soup
Franks and Kraut
Meatburgers

Smoked Shrimp Pate
Curried Lamb
Pork Chops
Lamb Chops
Chicken a la King
½ Chicken Cut-Up
Sweet-Sour Pork
Chicken Fricassee
Beef and Gravy w/Rice
Vienna Sausage w/Barbecue
  Sauce
Thuringer Loaf
Salami Loaf
Smoked Luncheon Loaf
Thuringer Sausage

*Samples received from more than one source.

Many of the samples from industrial sources were eliminated from further study because of low acceptability ratings, lack of utility, low production potential or any combination of disqualifying attributes.

It is hoped that new products will be made available for military evaluations. All items which are developed but are not adapted to the commercial market should also be submitted for examination as to their suitability for military use.

CANNED MEATS (B)

PROBLEM. Determination of the number and kind of microorganisms causing canned meat items to have a shelf life of less than 1 year at 100° F.

PRESENT SITUATION. Industry and some colleges and universities have been studying for the past several years the number and kind of microorganisms which contaminate canned meat during its manufacture. These organizations have also been studying the number and kind of microorganisms which survive accepted standards of heat treatment for stability for certain kinds of canned meat products. A part of this study has been on the effect of such agents as salt, sodium nitrate and sodium nitrite on the ability of these microorganisms to survive the stability heat treatment. There is very little published information in this field, primarily because it is an industrial problem and each member of industry is faced with a slightly different aspect of the problem in his plant because of varied geographical locations.

Usually, putrefactive anaerobes are considered to be the major causative factors of spoilage of canned meats. Representatives of this group have very high thermal resistances. The three highest which might possibly be encountered are PA 3679, *Clostridium sporogenes* and *Clostridium botulinum*. In the case of PA 3679 the thermal process to destroy very low numbers is relatively very high —1½ to 3 minutes at 250° F. In the case of *Clostridium sporogenes* and *Clostridium botulinum* it is very much lower. In the absence of the three putrefactive anaerobes of high thermal resistance, the required thermal process to reach sterility should be quite low—as low as F_0 0.1 in fact. Actual observations show that this is not true. To obtain a product known to be free of these three anaerobes it has been repeatedly found that processes above F_0 0.2 are required for sterility. Unpublished data indicate that the thermal resistance of aerobic or facultative anaerobic spore formers suspended in meat is much higher than the values recorded in the literature as maximum for these types of organisms. Thus it is becoming apparent that putrefactive anaerobes alone are not the limiting factor in determining minimum processes for producing sterile canned meats. There is another complicating factor. Although there is good evidence that spores of the three most heat-resistant anaerobes do not germinate in properly processed cured canned meat products even on long incubation, recent unpublished work shows that spores of facultative aerobes (Microaerophiles) can and do germinate in cured canned meat products processed to values insufficient to destroy all such spores present. This brings up a new consideration in safe processing levels for stable cured canned meat products. In fact it appears to present a barrier to lower levels of safe, stable heat processing of cured canned meat at this time. Thus, although the industry program of recent years has resulted in improved sanitation and more rigid temperature control and conditioning and has been reflected in a drastic change in the processes required to reach sterility in cured canned meat products, this does not mean that a yet more drastic lowering of processes is indicated or safe at least until further technological improvements can be made. The reason is that putrefactive anaerobes are not the only hazard and that other organisms normally present may become the limiting factors for safe operation. It will be appreciated if additional information of this type is made available.

CANNED SEAFOOD (C)

PROBLEM. Development of acceptable canned seafood products with storage life of at least 1 year at 100° F.

PRESENT SITUATION. Available canned seafood items are limited from the standpoint of variety. Items such as salmon and tuna have been used in the rations, but combination items, utilizing seafood products, have not been tried or have met with low acceptability. These items, as required for the Operational Rations, must be palatable when eaten cold and otherwise acceptable to the men in the Armed Forces. Increasing the number of acceptable canned seafood items to supply variety in the rations is required. Commercial products meeting these requirements are needed for military evaluation.

Perishable and Semi-Perishable Products

Introduction

Three-way boneless beef reduced shipping space two-thirds and weight one-third: the weight of veal and pork 30 percent, lamb 10 percent, and chickens 25 percent, and their space requirements one-third to one-half. Recent work on boneless beef has resulted in further elimination of material which would not be eaten (additional over-all saving in space and weight of 10 percent.) It also has great acceptability because necessary precautions are taken to assure its proper preparation.

Research results indicate that attainment of a moisture-salt ratio of 5 to 1 or less in canned bacon provides satisfactory stability. The current canned sliced bacon specification provides for a product with a salt content which is acceptable but not desirable. Further, this product is contained in a 24-ounce can and has been pasteurized so that it can be used in operational rations where cooking facilities are not always available, and in order that a more economical and larger pack of this product might be made available for large-scale feeding operations, packing of the sliced bacon in 7½-pound cans was investigated. This larger pack is not pasteurized and therefore must be cooked before eating. The product which was stored at 72° and 100° F. for one year showed remarkably good keeping qualities throughout the entire storage period. Standards were written into specification form to enable procurement of this larger pack of canned sliced bacon.

A storage test has commenced on the evaluation of black pepper flavoring in pork sausage. After preliminary tests conducted to determine proper seasoning (or flavoring) formulation and fat level for optimum acceptance, the following seasoning formula was judged most satisfactory: salt 1.75 percent; black pepper 0.312 percent; sugar, white, 0.25 percent; and sage (Dalmatian) 0.125 percent. It was further determined that there is no significant difference in the acceptability of pork sausage patties with a fat content of 30 to 50 percent, but fat content exceeding 30 percent makes cooking the pork sausage difficult, and nothing is gained in the final weight of the patties because the additional fat cooks out.

There is a definite movement on the part of some segments of the poultry industry toward scalding poultry at higher scalding temperature than the 130° F. currently specified in Military Specification MIL-C-10467 (QMC). Opinions of technical and production people differ on the practicability of higher scalding temperatures, and since it has been estimated that scalding temperatures approximating 140° F. will reflect a savings in excess of $250,000 annually in production costs, the matter is being investigated. A test involving 966 commercial fryer chickens has been started. Dressed, ready-to-cook, whole, and ready-to-cook, cut-up birds are involved.

Specifications covering frozen raw boneless turkey have been developed. The present specification covers three designs of commercially available frozen raw boneless turkey and will serve in the interim until such time as a single product can be developed for all Armed Forces use.

In a test to determine damage to functional properties of pasteurized frozen whole eggs for table service, liquid whole egg melange was preheated to 140° F. ± 1° F. and held for varying times to four minutes. Samples were taken at one-minute intervals. Initial and six-month evaluations were made. Results indicate that the difference in functional properties between unpasteurized and pasteurized whole eggs is not sufficient to exclude pasteurization, with its resultant protection from toxic and toxin-producing organisms, when the product is to be used for such items as scrambled eggs, omelets, and the like. Also, the fact that pasteurized eggs in sponge cake provide only slightly less volume than the unpasteurized eggs should not preclude their use by the Armed Forces.

CANNED BACON

PROBLEM. Production of an acceptable canned bacon with storage life of at least 6 months at 100° F.

PRESENT SITUATION. Canned sliced bacon has a high salt content (5 percent) which, while contributing to its stability, also gives it a relatively low acceptability. Stability may be obtained with a low salt content ($2\frac{1}{2}$ percent) if a moisture-salt ratio of approximately 5 to 1 is maintained in the finished product. Extension of laboratory findings to large-scale production is necessary. Industrial participation in adapting laboratory findings to large-scale production would be most useful in advancing this problem to a solution.

MILD-FLAVORED HAM AND BACON

PROBLEM. Provision of highly acceptable mild-flavored ham and bacon with storage life of 6 months at 100° F. and 1 year at 72° F.

PRESENT SITUATION. Available mild-flavored cured hams and bacons are subject to microbial and chemical deterioration unless refrigerated. Products which will retain desirable flavor and texture characteristics without refrigeration are required. Industrial participation in pilot plant and storage studies on lard-packed hams would be of material aid in progressing this problem to a solution.

SAUSAGE PRODUCTS

PROBLEM. Improvement of existing and development of new sausage products adaptable to military needs.

PRESENT SITUATION. There presently exist, in specification form, requirements for bologna, frankfurters, liver sausage, luncheon meat, pork sausage, cervelat, farmer-type sausage, and salami. The products supplied according to these specifications show deficiencies in meat and spice formulation and, in addition, have extremely poor keeping quality in freezer storage. The cooperation of industry would be valuable in the development of standards for new sausages and improvement of existing sausage products. At least 6 months freezer storage stability is desired.

FROZEN LAMB

PROBLEM. Provision of highly acceptable frozen ready-to-use consumer cuts of lamb, utilizing the entire carcass.

PRESENT SITUATION. Frozen telescoped lamb (hind legs inserted in the chest cavity) offers a saving in space requirements during shipping and storage of approximately 40 percent over carcass lamb. The product does not provide an appreciable saving in shipping weight. A further disadvantage is the necessity of having skilled butchers at the point of use. A prefabricated lamb product, consisting of chops, roasts, and ground meat, would yield potential savings of more than 50 percent in space requirements, 25 percent in weight requirements, and partially solve the skilled butcher problem. Detailed information for specification purposes is required.

FROZEN VEAL

PROBLEM. Provision of highly acceptable frozen ready-to-use cuts of veal, utilizing the entire carcass.

PRESENT SITUATION. Currently, carcass veal and semi-boneless veal specifications are available. Carcass veal is wasteful of weight and space during shipment and storage and, further, requires skilled personnel for processing in the kitchens of the Armed Forces. Semi-boneless veal is a good product but is not economical because it utilizes only 48 percent of the veal carcass. Present thinking is toward the design of a boneless veal product divided into three categories, namely: (1) roasting, (2) cutlets, and (3) ground veal and pork (for loaves and patties). Industrial assistance in developmental and pilot plant stages would provide a practical, workable specification.

FROZEN BONELESS TURKEY

PROBLEM. Provision of a highly acceptable frozen boneless turkey.

PRESENT SITUATION. The Armed Forces are using, principally, frozen ready-to-cook turkeys, resulting in the conservation of space and weight in shipping and storage and time in kitchen preparation. A further savings could be effected if a suitable boneless turkey product could be developed for overseas supply which would be price-competitive with whole ready-to-cook turkey by furnishing only the edible portion of the product. Evaluation of several commercial boneless turkey products demonstrated the following deficiencies: (1) poor slicing quality, (2) poor keeping quality due to the development of rancidity, and (3) failure to include all servable meat.

It is believed that a two-way division of the meat of boneless turkey into a roasting category and a giblet category (small pieces of meat, heart, gizzard), should be investigated to provide boneless turkey competitive with whole ready-to-cook turkey. The cooperation of industry in resolving this problem would be helpful.

FROZEN SEAFOOD PRODUCTS

PROBLEM. Development of acceptable fillets, steaks, and dressed fish products with a freezer storage life of at least 12 months.

PRESENT SITUATION. The use of greater quantities of fish in Armed Forces rations is desirable because of the large potential supply, the reasonable cost of a rich protein food, and the need for increased variety in the rations. There are many problems. Information is not available on the eating and keeping qualities of all the species of fish currently being marketed. A system must be developed for determining their relative acceptance as well as their keeping qualities under various conditions of freezer storage. The cooperation of industry will be required.

Dehydrated Products

Introduction

During World War II dehydrated meat was used to conserve space and weight, but shelf-life and utilization properties were inadequate. By 1949 a specialized dehydrated meat with nearly satisfactory military characteristics was developed.

During the past year the following meat products, dehydrated by several different methods, have been evaluated in the search for a suitable military item: whale meat, ham slices, ham and eggs, corned beef hash, meat and rice, raw ground beef, dehydrated shrimp, jerked beef, Pemmican, ground meat and spaghetti, raw sliced steak, precooked sliced steak, meat and gravy, meat and vegetables with gravy, and dehydrated stew meat. Of these products, only two, dehydrated shrimp and jerked beef, were sufficiently satisfactory to warrant stability studies. After three months at 100° F., these products began to show signs of deterioration, with accompanying lowered acceptance ratings. The idea of a sliced dehydrated steak has been shown to be sound. The precooked product examined indicated a good rehydration rate and a fairly pleasing taste, except for a slight flavor of stale fat. Sufficient samples were not available to initiate stability studies.

Analysis and evaluation of Meat Food Product Bars stored at 100° F. for 18 months was completed. Chemical analysis indicated more of a breakdown in the bars stored at 100° F. than at 40° F. In each case the control sample (or standard bar) stored for like periods at —20° F. showed little or no significant difference in chemical analysis from its accompanying test sample. An important point to be noted is that by routine analysis (peroxide value and free fatty acid content) all samples stored for 18 months showed little or no difference chemically from bars initially examined. Indications are that chemical changes taking place are of a proteolytic nature. Organoleptic evaluation of all storage samples throughout the 18-month period showed a periodic increase in acceptability over the initial examination up to and including the six-month withdrawal period. After the six-month period all bars began to drop in acceptability. Although the bars were still acceptable at the end of the 12-month period, at the end of the 18-month withdrawal period the bars and a "Browned Meat" dish prepared from the bars rated as unacceptable.

The effect of dehydration on the cellular structure of meat has been found to be: (a) a progressive fiber shrinkage which can be measured directly in terms of fiber diameter; (b) a gradual disappearance of endomysial space; (c) an early disappearance of the longitudinal striations and a less severe effect on the defination (microscopic visibility) on the cross striation of the muscle fibers; (d) merging of muscle fibers in close contact; (e) movement of potassium ions from their original position in the cross striations of the periphery cells; and (f) meats which were electrolyzed with 200 ma. for 30 minutes absorbed water and became macerated rapidly and histochemically showed evidence of re-orientation of the mineral constituents upon rehydration.

Two separate studies are being conducted which relate to the stability of dehydrated egg as follows: (1) Comparative stability study of MIL-E-10006 (QMC) and glucose-free dehydrated eggs prepared by treatment with glucose oxidase. The technical objective of this study is to compare the keeping and functional properties of dehydrated egg from which glucose was removed by glucose oxidase with the same properties of the Army specification (acidified) egg. (2) Comparative stability study with Western Regional Research Laboratory on MIL-E-10006 (QMC) specification eggs and yeast-fermented glucose-free dehydrated egg. Technical objective the same as above except that glucose was removed by fermentation.

DEHYDRATED PRECOOKED MEAT PRODUCTS

PROBLEM. Development of palatable dehydrated precooked meat products with storage life of at least 1 year at 100° F.

PRESENT SITUATION. Dehydrated corned beef hash and dehydrated meat and rice deteriorate within three to four months at 100° F. They develop fishy and metallic flavors, the meat turns dark, and hard particles remain after the reconstitution period of ten minutes. A dehydrated meat bar has been developed which is performing satisfactorily in special rations. Dehydrated steaks, chops, hamburgers, and other varieties of meat products are required which will retain flavor, color, and texture comparable to fresh meats prepared in the same manner.

DEHYDRATED WHOLE EGG POWDER

PROBLEM. Improvement of dehydrated whole egg powder to obtain optimum acceptability after storage for 1 year at 100° F.

PRESENT SITUATION. Manufacturing and storage studies on dehydrated stabilized egg powder (acidified) have been completed and a specification is published. Dehydrated stabilized egg powder has proved to have twice the shelf-life of the unacidified powdered eggs formerly used by the Armed Forces. In the interests of producing a still better dehydrated egg product it will be necessary to evaluate the result of experimental work conducted in industry and by the U. S. Department of Agriculture on fermented and enzyme-treated dehydrated whole egg powder. Industrial participation in pilot plant and storage studies comparing improved products would be helpful.

Cereal and Baked Products

Introduction

Cereals and baked products have been in the past and are at present basic to the military rations. Over the years variety has increased greatly. Bread was at one time virtually the only cereal available. At present a wide variety of products is available, the result of continued effort and research directed toward the development of items meeting military requirements of use. Much work in improving the storage stability of these products remains to be done, and the variety of types available to the troops can profitably be increased still further.

Progress has been made in the last year in solving the problems listed in previous editions of this booklet. The number of premixed cereal types has been doubled; a coconut cookie has been developed which appears to be highly acceptable, and canned bread has been brought to the point where large volume production is feasible. Many problems are still to be solved, however, and some of these are listed here.

DEHYDRATED SOUPS

PROBLEM. Development of acceptable egg noodles and rice products which will be instantly reconstitutable in boiling water.

PRESENT SITUATION. Variety and acceptability of dehydrated soups can be greatly increased by the inclusion of immediately reconstitutable egg noodles and rice products. Such items are useful under conditions where cooking is difficult. Currently available items require at least three minutes (rice) or seven minutes (noodles) of actual cooking. The desired products must be ready to eat wthin five minutes after addition to boiling water when no additional heat is supplied.

CAKE MIXES

PROBLEM. Development of cake mixes requiring only the addition of water prior to mixing and having a minimum storage life of 12 months at 100° F.

PRESENT SITUATION. There is some indication that the moisture content of flour used in cake mixes should be below 8 percent, but the optimum moisture has not been determined. Reduction of the moisture substantially below 8 percent introduces problems of the keeping quality of the flour itself and may adversely affect its baking quality. Deterioration of cake mixes during storage is at least partially attributable to deterioration of shortening. The shelf life of some cakes containing granular shortening approximates 6 months at 100° F., but these are of marginal acceptability at the end of the storage period. While some yellow and chocolate cakes approach the desired shelf life, white and spice cakes with the desired characteristics need to be developed.

COOKIES FOR RATIONS

PROBLEM. Additional varieties of cookies that are stable for 6 months at 100° F. are needed for operational rations.

PRESENT SITUATION. Three varieties of cookies are purchased for operational rations, sandwich cookies with butterscotch filling, sandwich cookies with chocolate filling, and an oatmeal, chocolate-chip cookie. There is a need for more variety. In addition to stability requirements of 6 months at 100° F., these cookies should be highly acceptable. It is preferred that they be made on a Dutch Cookie Machine rather than a wire cutting machine since the critical edge dimensions can be controlled better on the Dutch apparatus.

SURVIVAL RATION

PROBLEM. Development of a low moisture (1-5 percent) cereal food for a multi-purpose survival ration. This product must contain at least 25 percent biologically nutritious protein, 30 percent fat, 1 percent salt and the remainder carbohydrate. The ration must have a storage life of 6 months at 100° F.

PRESENT SITUATION. Nutritional studies indicate that an all-purpose survival bar should contain a considerable amount of fat and protein. Such a bar must maintain a high degree of acceptability during storage and must not be excessively thirst provoking. Acceptable protein supplements are those from egg and milk, and the fat must be in a highly stable form.

PREMIXED CEREALS

PROBLEM. Development of new and improved premixed cereals which have a storage life of at least 6 months at 100° F.

PRESENT SITUATION. The existing specification for premixed cereals has proved unsatisfactory. Additional premixed cereal products are needed to achieve greater variety. Newly developed ready-to-eat cereals should be utilized in premixed cereals. Specific formulas, ready-to-eat cereal quality standards, and general processing methods are required for specification purposes.

CANNED BAKED PRODUCTS

PROBLEM. Development of methods for inhibiting or retarding rust formation in canned baked products.

PRESENT SITUATION. Rusting of cans containing baked products such as bread results in discoloration of the products. The discoloration, though presumably harmless, can easily be mistaken for mold and may result in loss of the product. Rusting occurs principally along the side seam and along scored areas of the can. Improvement of containers or modification of processing methods to eliminate discoloration of the product is required.

WHOLE WHEAT BASE

PROBLEM. Development of a wheat concentrate with a storage life of 6 months at 100° F.

PRESENT SITUATION. Since the only flour available to overseas Armed Forces bakers at the present time is white flour, the variety of bread available to overseas troops is extremely limited. Whole wheat flour cannot be supplied because it is notably unstable. Preliminary experiments have demonstrated that the equivalent of whole wheat flour can be supplied through the use of a whole wheat flour concentrate which has been stabilized by a mild heat treatment. The base, consisting of that portion of the wheat berry remaining after the straight grade flour has been removed, is added to white flour prior to bread making. Experimentation on the part of manufacturers is required to determine whether or not the wheat concentrate with the required stability charactertistics can be manufactured on a commercial scale.

FOIL-WRAPPED BREAD

PROBLEM. Improvement of the acceptability of foil-wrapped bread after storage for 3 months at 100° F.

PRESENT SITUATION. This product is to be prepared by troops in rear areas for consumption within short periods after baking. It is not intended to replace freshly baked bread when baking equipment is available, nor does it replace canned bread in packaged rations. At present, aluminum foil-wrapped with cellophane is used as the wrapper for this product. With the present formula and processing procedure, this wrapper assures palatability of the bread for 100 days at 70° F. Improvements in formulation processing procedure, and/or the wrapper are required to increase the storage life of the product at temperatures higher than 100° F.

BAKING POWDER

PROBLEM. Definition, for specification purposes, of baking powders with storage life of 6 months at 100° F.

PRESENT SITUATION. Baking powder currently procured has only to meet the requirements of the Federal Specification for Type 1 Baking Powder. This specification allows too great a variation in quality of ingredients and has a lower required available CO_2 content than baking powder produced in accordance with good commercial practice. Since baking powder which meets the Federal Specification may be below standards accepted by industry, the specification should be rewritten to include the higher standards attainable by industry.

CANNED PUDDINGS

PROBLEM. Development of new and improved canned pudding products.

PRESENT SITUATION. Existing specifications for steamed puddings (plum, fig, date, fruit, and fruit cake) are inadequate to insure procurement of satisfactory products because formulas, quality of raw materials and finished product requirements are specified only very generally. More definite specifications covering formulas, raw materials and finished products are desirable. Inasmuch as the existing varieties are so similar in flavor and texture as to become monotonous, consideration of new varieties is indicated. Baked or steamed puddings of the following types are suggested: apple, apricot, banana, butterscotch, cabinet, chocolate, farina, mincemeat, Nesselrode, pineapple tapioca, and cherry cobbler.

CANNED CAKES

PROBLEM. Preparation of canned pound cake, date-nut roll, and chocolate-nut roll with a minimum storage life of 6 months at 100° F.

PRESENT SITUATION. These products have shown high acceptability and appear to be adaptable to operational feeding. The QMF&CI has developed a canned pound cake which possesses the necessary military characteristics. Canned chocolate-nut roll and date-nut roll products are available commercially, but information is desired from which specifications can be prepared which will insure delivery of other equally acceptable products.

CANNED BREADS

PROBLEM. Development of canned bread with the acceptability of "bakery-fresh" bread after storage for 6 months at 100° F.

PRESENT SITUATION. Canned bread as now produced has been received with greater enthusiasm than biscuits or crackers, but the product after storage lacks the desirable texture and flavor characteristics of freshly baked bread. Preliminary work indicates that improvements may result by increasing the density and by modifications in formulation. Further study and complete evaluation of such modifications are desired.

CANNED RAISIN BREAD (A)

PROBLEM. To provide a canned raisin bread which will not discolor in the areas adjacent to the raisins and which will have a storage life of at least 6 months at 100° F.

PRESENT SITUATION. Canned raisin bread is a highly desirable item for the rations, but to date no means of preventing the undesirable transfer of color from raisins to the surrounding bread has been achieved. A method is required for preparing a canned raisin bread which will retain its original appearance and acceptability.

CANNED WHOLE WHEAT BREAD (B)

PROBLEM. Provision of a palatable canned whole wheat bread with a minimum storage life of 6 months at 100° F.

PRESENT SITUATION. Canned whole wheat bread would be a desirable supplement to the canned white bread now available. Because of the differences in composition of whole wheat and white flour, the formula and process for canned white bread require considerable adaptation before a canned whole wheat bread can be produced. A method for overcoming the pronounced buffering action of the flour and producing a product of pH 5 or lower is required.

DEHYDRATED MOLASSES

PROBLEM. Provision of a non-hygroscopic molasses powder for use in gingerbread cake mixes.

PRESENT SITUATION. Available dry molasses products are sufficiently hygroscopic to take up moisture which is subsequently transferred within gingerbread mixes, resulting in the release of leavening gases in which the moisture is concentrated. The hygroscopic characteristics also cause problems during blending of the cake mixes. Provision of a non-hygroscopic dry molasses product which will eliminate significant changes in moisture distribution within the prepared mix is required.

RYE BASE

PROBLEM. Development of a rye base having a rye flavor and having a storage life of 6 months at 100° F.

PRESENT SITUATION. The only flour available to Armed Forces in the overseas area is white flour. Rye flour cannot be supplied because it is extremely unstable. Thus, in the summer months, rye flour cannot be stored more than 6 weeks without going off-condition. A stable rye base is being sought that can be added to white flour to give it the characteristic rye flavor and appearance of American-type rye bread.

COLOR DETERMINATION—Alimentary Pastes

PROBLEM. To develop a method for the measurement of the color of alimentary pastes for grading purposes.

PRESENT SITUATION. The quality of macaroni and noodles depends to a great extent on the quality of the durum semolina used. Semolina quality is related to its protein content, ash content, and color. While we are able to objectively determine protein and ash, no objective measure of color is available. As a consequence, quality cannot be properly controlled. A method of color analysis is desired.

EGG CONTENT ANALYTICAL PROCEDURE

PROBLEM. In some instances the military characteristics of cereal products are dependent upon the quantity of egg solids (albumen and/or yolk) used in their manufacture. Accurate and reliable analytical procedures are needed for procurement and inspection purposes.

PRESENT SITUATION. The cholesterol analytical method for egg yolk solids is excessively tedious, complicated, and time consuming for routine inspection. The alternative lipoid phosphoric acid (P_2O_5) analytical method has been found unreliable in many instances. An analytical procedure for determining egg albumen content in complex mixtures is non-existent. The development of rapid, accurate and reliable analytical procedures for determining egg albumen solids and egg yolk solids content is needed for inspection purposes for assurance that supplied cereal products (such as noodles, prepared bakery mixes, and meringue powders) comply with specification requirements.

BISCUITS FOR RATION

PROBLEM. The acceptability of soda crackers prepared for operational rations is lower than it is in similar civilian products. Improvement in acceptability is desired.

PRESENT SITUATION. Reports from the field indicate that soda crackers produced for our rations are not completely acceptable. Tests indicate that a thinner cracker similar to that made for the commercial market is needed. Definite limitations on thickness are imposed by the fragility of the crackers, for if they are too thin, they break during military handling. Methods of preventing such breakage are needed. Both packaging and formula changes are being considered.

ACTIVE DRY YEAST

PROBLEM. The storage stability of active dry yeast is less than desired for military supply channels. A more stable active dry yeast is desired.

PRESENT SITUATION. A test has begun in which a variety of canning atmospheres and storage conditions are being tested. Some work is being sponsored on the effect of additives on the stability of active dry yeast. Further work is necessary especially on the isolation of more stable yeast strains.

COMPRESSED PREMIXED BREAKFAST CEREALS

PROBLEM. To develop a variety of breakfast cereals containing dry milk and sugar which when in a compressed form are stable enough for military field use.

PRESENT SITUATION. It has been found that flake-type breakfast cereals and granular-type breakfast cereals can be compressed satisfactorily but puffed-type breakfast cereals cannot. Moreover, all of the cereals barely meet the stability requirements set up (6 months at 100° F.). Work is under way seeking a method of compression of puffed cereal products and seeking methods of improving the storage stability of cereal products.

Dairy, Oil and Fat Products Problems

Introduction

The primary responsibility of the Dairy, Oil and Fat Products Division is to develop milk and fat products which are suitable to the Armed Forces from the standpoint of palatability and extended shelf life. The problem of providing beverage milk occupies a prominent position in the program. Numerous industrial developments provide partial solutions to this problem. In most instances, however, further improvements of the developments which are suitable for commercial usage are necessary to make them practical for military feeding. Similar situations exist in the development of cheese products and fat spreads for bread. To obtain adequate dairy and fat products, mutual cooperation of industry and the Armed Forces is clearly essential.

Milk Products

DRY WHOLE MILK (A)

PROBLEM. Provision of a product, which, after storage for six months at cold (—20° F.), warm (100° F.), and at fluctuating temperatures will reliquefy easily and completely without mechanical equipment, in cold water, and which will be free from chalky, heated and other undesirable flavors. The beverage milk should closely simulate fresh milk.

PRESENT SITUATION. Premium grade whole milk powders are stable with respect to oxidative deterioration. They will not, however, completely reliquefy even when mechanical equipment is used. In addition, chalky and heated flavors are present in the resulting milk. These atypical flavors and the undispersed particles contribute to rejection and waste of the beverage product in Army installations.

Complete information is lacking as to the causes of atypical flavors and the limited rehydration properties in dry whole milk. Current investigations carried on in the Institute laboratories and by several cooperating universities are concerned with studying existing manufacturing methods in relation to over-all improvement.

New approaches which may lead to the solution of the problem are needed and suggestions will be welcome. Improved methods to accurately measure completeness of reliquefication are required. Suggestions and developmental assistance from the industry are invited.

DRY WHOLE MILK (B)

PROBLEM. Provision of additional specification tests, supplementing the standard grading procedure, which will permit selection of currently available products with the greatest acceptability and longest storage life.

PRESENT SITUATION. Present grading procedures for dry whole milk, based largely on "solubility index," moisture, oxygen content of the headspace gases, copper, iron, and sediment determinations, group available products into broad quality groupings, but are not sufficiently precise to permit differentiation of superior products from marginal products within a group. Furthermore, although the grading procedures are based upon factors known or believed to affect storage life, prediction of acceptability of products after six months' storage at 100° F. on the basis of grade is inaccurate. Evaluation of more precise methods for determining solubility, for determining the extent of heating during processing, for estimating susceptibility to staling and oxidation, and any other methods which will provide accurate indices of acceptability and potential storage life are required.

FLAVORED DRY MILK PRODUCTS

PROBLEM. Development of a flavored dry milk product with good reconstitution properties, desirable flavor and stability at 100° F. for six months.

PRESENT SITUATION. All products submitted have been difficult to reconstitute initially or after storage at 100° F. Chocolate flavored products have been the most popular. All products have decreased in acceptability on storage. Products which will reconstitute in cold or hot water by mild stirring in a cup with a spoon which retain flavor after storage at 100° F. are needed to fill the intended use; namely, a beverage milk for combat rations.

NONFAT DRY MILK SOLIDS

PROBLEM. Provision of specification tests for nonfat dry milk solids intended for beverage use to determine extent of heating during processing.

PRESENT SITUATION. Recombined milk, prepared from anhydrous milk fat, nonfat dry milk solids, and water is used for beverage purposes where facilities for recombination are available. The quality of recombined milk is partially dependent upon the quality of the ingredients. The bulk of the nonfat dry milk solids produced, intended principally for baking purposes, is not satisfactory for beverage use because of the excessive heat treatment it has received. Because of the large quantities of beverage grade nonfat milk solids now required, analytical methods which may permit estimation of the extent of heating during processing are required. Methods for determining extent of heat treatment are being studied by the QMF&CI, and industry and the Associates.

Continued evaluation of test methods proposed is desired and assistance in interpretation of results will be welcome. Continued contribution of samples of high and low heat powder from many producers from various parts of the country is invited.

EVAPORATED MILK

PROBLEM. Development of an evaporated milk which does not require turning in storage.

PRESENT SITUATION. Evaporated milk as presently produced requires turning, generally at monthly intervals, to avoid separation and sedimentation. This results in a serious waste of manpower. Although in some warehouses the difficulty has been reduced somewhat by mechanical turning of palletized cases, turning of packaged rations containing evaporated milk is virtually impossible. When evaporated milk is not turned, serious economic loss results.

STERILE BEVERAGE MILK

PROBLEM. Development of palatable sterilized whole milk with a storage life of at least six months at 100° F. and unaffected by freezing temperatures.

PRESENT SITUATION. A palatable sterilized whole milk, preferably canned, is required when:

a. Satisfactory dry whole milk is unavailable,
b. Water for rehydration of a dry product is unavailable,
c. Rehydration is impractical or impossible because of the tactical situation.

Evaporated milk is not suitable for a beverage because of its cooked flavor and the necessity for dilution. Whole milk (flash sterilized and packaged and also that sterilized in the can) is available in glass and metal containers, but stability does not approach that which is required. Further work on production of such a product and submission for evaluation and stability study is desired.

CONCENTRATED MILK

PROBLEM. Development of concentrated milk for use, after reconstitution, as beverage milk that does not require refrigeration or, if refrigerated, has increased stability.

PRESENT SITUATION. Concentrated milk, unless frozen, has no greater storage life than fresh liquid milk. A fluid product with a storage life equal to or greater than the frozen product or a sterile product that does not require refrigeration is needed. Industry working on this product is invited to submit samples for evaluation and stability study.

FROZEN MILK

PROBLEM. Development of frozen milk and frozen concentrated milk which will not separate when transported or stored at 20° F.

PRESENT SITUATION. Considerable loss of frozen milk is caused by lack of suitable refrigeration facilities aboard ship and on shore. Temperatures of approximately 20° F., rather than the optimum of −10° F., are generally encountered. A product, the quality of which can be maintained at existing temperatures, is required. Samples of suitable frozen products should be submitted for evaluation.

DRY CREAM

PROBLEM. Development of a palatable dry cream that will disperse readily in hot coffee and tea and have a storage life of six months at 100° F. Development of a product readily dispersible in cold water for use as fat source with reconstituted skim milk to produce a beverage milk.

PRESENT SITUATION. Dry cream is needed for group and individual feeding away from organized messes, but all products examined to date have lost dispersibility or have become unpalatable within three months at 100° F. A dehydrated modified sweetened milk developed in conjunction with an industrial concern exhibits the properties desired, but production of a satisfactory dry cream may improve the color of the coffee in which the product is used and may remove any possible objection to the added sugar in the sweetened product.

Manufacturers of dry milk products are invited to submit samples of dry cream for evaluation and stability study.

CANNED STERILE CREAM

PROBLEM. Development of a canned sterilized 30 percent cream which will have a storage life of not less than six months at 100° F.

PRESENT SITUATION. Palatable "recombined" beverage milk can be prepared from a fat source, nonfat dry milk solids, and water. Anhydrous milk fat is used successfully as the fat source when necessary homogenization equipment is available. Where no equipment is available for recombination of anhydrous fat, the fat source should be cream, concentrated to at least 30 percent fat to eliminate shipment of excessive quantities of water. Cream containing 18 percent butterfat has a reasonably good storage life but 30 percent cream shows separation within 2-4 months as evidenced by "cream plug" and/or separation of free fat. Cream containing 30 percent butterfat has shown satisfactory stability at the end of six months at 100° F., but is packaged in glass. A metal container is desired to eliminate loss due to breakage.

It is hoped that commercial organizations which produce canned sterile cream will submit their products for evaluation.

FAT SPREADS

PROBLEM. Provision of a spread for bread that has a storage life of at least six months at 100° F., will not separate on freezing, can be consumed as produced or is readily reconstituted, and is comparable in acceptability to butter scoring 92-93 at time of testing.

PRESENT SITUATION. Attempts to produce a fat spread for bread which will remain stable and be usable over a wide range of temperatures have thus far been partially or completely unsuccessful. Preparations stable at low temperatures cannot be spread at low temperature and oil off or separate at high temperatures. Products which are stable at high temperatures are destabilized by freezing. Increase in the over-all range of stability has generally resulted in reduced palatability. A palatable universal spread would be useful particularly in unit operational rations.

CHEESE SPREADS

PROBLEM. Provision of a palatable canned cheese spread which will remain satisfactory after six months' storage at 100° F. and which will maintain a stable emulsion within the range of —40° F. to 120° F. intermittently without adverse effect on keeping quality.

PRESENT SITUATION. During World War II, cheese spread was probably the most acceptable of the Army spreads for bread. As developed then and still provided for under specification, the finished product leaves much to be desired when stored under conditions of extreme cold. Improvement in the physical stability is needed. The plain variety and those containing smoked meat and smoked meat and relish are the only formulations included in the current specification. New formulations are required to provide variety of these spreads. New ideas in packaging which will maintain stability yet induce more convenient means for utilization of the product are required.

ARMY SPREAD

PROBLEM. Provision of analytical and sanitary control procedures for Army Spread to eliminate possibilities for bacteriological spoilage.

PRESENT SITUATION. Bacteriological spoilage of Army Spread has been encountered. Adequate control of quality of raw materials, particularly the butter and cheese cure, and close attention to formula details, particularly concentrations of salt and sodium benzoate, may eliminate the possibilities for bacteriological spoilage. Information necessary to revise the present specification to provide the necessary control is required.

MILK FAT

PROBLEM. Development of a milk fat which will have a storage life of two years at 70° F.

PRESENT SITUATION. Recombined milk prepared from anhydrous milk fat, nonfat dry milk solids, and water is being supplied to troops overseas in areas in which facilities for recombination are available. The anhydrous milk fat now used is satisfactory if refrigerated during shipping and storage. A fat which requires no refrigeration is needed.

Information on new developments concerning this product which will increase stability will be welcomed.

CANNED MARGARINE

PROBLEM. Development of a palatable canned margarine with a storage life of at least six months at 100° F. which will not oil off at 100° F., will be stable after subjection to temperature of −40° F. and will be spreadable at 45° F. Develop objective tests for measuring spreadability.

PRESENT SITUATION. Margarine may be useful at lower temperatures, though not for temperatures above 90° F. Information on the relationship of palatability and storage life to such factors as type and degree of hydrogenation of oil, presence of antioxidants, degree of acidity of the skim milk, type and concentration of emulsifying agent, and concentration of salt is required to prepare a specification. Margarine and related industries are invited to cooperate with the QMF&CI in developing desired margarine and test methods.

ALL-PURPOSE SURVIVAL RATION BAR

PROBLEM. Development of a low moisture (under 5 percent) nutritious product capable of sustaining life during a period of emergency survival, regardless of geographic location or climatic conditions. The food and package must withstand repeated freezing and thawing and shall be stable for one year at 100° F. and 90 percent relative humidity.

PRESENT SITUATION. Items required must possess nutritional property conducive to proper retention of physical stamina and mental capability for several days when subnormal caloric intake and limited water supply is necessary. A composition on a dry weight basis of 25-30 percent protein (corrected to 16 percent nitrogen), 30 percent fat, sodium chloride 0.6-1.2 percent, and carbohydrate up to 100 percent has been established as optimum. Cooperation is invited in the development of these food bars. Dairy products are to be considered an excellent source for the required ingredients.

ANTIOXIDANTS

PROBLEM. Provision of antioxidants for fat which will extend the storage life of food products containing fat as an ingredient.

PRESENT SITUATION. Available antioxidants are effective in prolonging the storage life of fats. Except for newly developed products, however, the effect of the antioxidant is generally lost or seriously reduced when the fat is introduced into other food products such as biscuits. Information which will allow selection of antioxidants to effectively extend storage life of fat-containing foods is required.

Industry is invited to submit new antioxidants to the QMF&CI and information on all antioxidants which might be utilized in the solution of this problem.

SHORTENING

PROBLEM. To enlarge the specification for shortening products to permit the utilization of suitable oil ingredients other than cottonseed and peanut oils and to specify antioxidants and other chemicals which will extend stability of shortening in baked and cooked products.

PRESENT SITUATION. Existing specifications for shortening limit the oil ingredients to cottonseed and peanut oils. Other oils are known to produce equally acceptable and stable shortening products, but the relationship of chemical and physical criteria to stability of these additional products is not clear. Improved methods of evaluation are required which will determine the stability of shortenings prepared from other selected raw materials such as soya and sunflower seed oils. Information on methods of determining stability of oils and stability of shortening containing oils other than those specified is desired.

Fruit and Vegetable Products Problems

Introduction

The importance of fruits and vegetables to the health and well-being of humans obligates the Armed Forces to supply these foods to the soldier to the greatest possible extent wherever he may be.

Dehydrated fruits and vegetables can be used under conditions which preclude from use the more acceptable forms of these foods such as fresh, frozen, and canned. In addition, they possess the obvious advantages of savings in weight, space, and critical materials, which are of paramount importance during times of emergency.

The problems listed herein are concerned with the improvement of presently available and previously produced dehydrated fruits and vegetable products from the standpoint of rehydration qualities, acceptability, and stability, and the development of processes for the production of new items which would extend the variety of available foods.

It is hoped that this publication will stimulate industry and other interested agencies to offer assistance along the lines suggested under the individual problems.

Dehydrated Products

DEHYDRATED VEGETABLES

PROBLEM. Provision of dehydrated vegetables (white and sweet potatoes, onions, corn, peas, green beans, tomatoes, cabbage, carrots, beets) meeting the following requirements:

a. Capable of rehydration by simple cooking procedures, involving cooking times not exceeding those required for preparation of the fresh products.

b. Have flavor, color, texture, and aroma, when rehydrated which are comparable to products prepared from fresh materials.

c. Possess a storage life of 6 months at 100° F.

PRESENT SITUATION. Dehydrated vegetables available during World War II were limited mostly to the root types, cabbage being the only exception. These products required prolonged soaking and cooking times. Quality of the prepared products has often been poor. Storage life of many of the items has been inadequate. Corn, peas, green beans, and tomatoes, which are of major importance as canned vegetables, are not currently available in dehydrated forms suitable for military procurement, although the outlook for a dehydrated corn is very encouraging. Reductions in piece size of dehydrated root items and changes in processing treatments have been suggested as means of improving rehydration characteristics. These proposed changes must be evaluated not only in terms of the immediate purpose, but also with respect to their effects upon acceptability, storage life, and packing densities. Assistance through consultation, laboratory investigations and evaluation of the production feasibility of new or modified items, processes and specification requirements would be appreciated.

DEHYDRATED FRUITS

PROBLEM. Provision of dehydrated apples, apricots, peaches, pears, cranberries, pineapple, cherries, strawberries, raspberries meeting the following requirements:

a. Capable of rehydration in 30 minutes by simple procedures.

b. Possessing, in the rehydrated forms, texture, flavor, and aroma comparable to similar items prepared directly from the fresh product.

c. Suitable for consumption in the dehydrated form.

d. Possessing a storage life of at least 6 months at 100° F.

PRESENT SITUATION. All of the items listed here have been prepared in dehydrated form, but fail to meet one or more of the requirements. Soaking periods of 2-4 hours are generally required in cold water. Heating the products to temperatures necessary to reduce rehydration time to 30 minutes results in a cooked product which may be objectionable for some purposes. Apple nuggets, dehydrated cranberries, and blanched dehydrated pears are comparable to fresh products when prepared as cooked fruit dishes. However, none of the items listed will rehydrate to forms comparable to the uncooked fresh products. All of the items could be consumed in their present dehydrated forms if necessary, although their acceptability would vary widely. Storage life of apricots, pears and peaches is only 2 months at 100° F. Apple nuggets and dehydrated cranberries have a storage life of 4 to 6 months at 100° F. Conclusive information on the storage life of the other items listed is not available. Assistance through consultation, laboratory investigations and evaluation of the production feasibility of new developments is invited.

DEHYDRATED PRECOOKED MASHED POTATOES

PROBLEM. Provision of dehydrated precooked mashed potatoes meeting the following requirements:

a. Capable of rehydrating to a mashed potato by the addition of water heated to the temperature range of 100° to 212° F., and stirring or whipping for a total mixing time of not more than two minutes.

b. Having, after rehydration, flavor, color, aroma, and texture comparable to a product prepared from fresh potatoes by conventional cooking methods.

c. Having a storage life of at least six months at 100° F.

d. Furnishing the highest possible number of calories compatible with requirements a, b, and c.

PRESENT SITUATION. The product presently procured under the existing specification is extremely dense. A sufficient quantity can be packed in a No. 10 tin for 100 servings. It rehydrates satisfactorily at approximately 160° to 180° F., but tends to become gummy at higher rehydration temperatures. Lot-to-lot variations in density of the dry product and in quality of the rehydrated product with respect to color, flavor and consistency also suggest further areas for improvement. The development of better processing methods and controls is indicated.

DEHYDRATED SOUPS

PROBLEM. Provision of dehydrated precooked pea, bean, onion, potato, and tomato soups meeting the following requirements:

a. Capable of rehydration by the addition of water heated to the temperature range of 100° to 212° F., and stirring one minute or less.

b. Having flavor, color, aroma, and texture comparable to those of soups prepared from fresh ingredients by conventional cooking procedure.

c. Possessing storage life of at least 6 months at 100° F.

PRESENT SITUATION. A process for the production of dehydrated precooked pea and bean soups, meeting the above requirements, has been developed in the Institute laboratories.
Dehydrated ingredients for the potato and tomato soups, which can be prepared by the addition of hot water and without further cooking, are obtainable, but conclusive data regarding the stability of soups prepared from these ingredients are required. Commercially available onion soup requires from 5 to 10 minutes cooking. Considerable success has been encountered in application of the laboratory developed process to volume production of precooked dehydrated pea soup. Continued assistance along these lines is needed to obtain optimum quality in the volume production item.

DEHYDRATED ORANGE JUICE

PROBLEM. Provision of a dehydrated orange juice meeting the following requirements:

a. Capable of rehydration within 3 minutes by stirring with cold water.

b. Having, after rehydration, flavor, color, and aroma of freshly expressed juice.

c. Possessing storage life of not less than 6 months at 100° F.

PRESENT SITUATION. Recent developments in a cooperating laboratory show promise of yielding a product approaching the above requirements. If work now in progress is concluded successfully, cooperation in the adoption of laboratory processes to production equipment will be needed.

FRUIT BARS

PROBLEM. Provision of additional palatable forms of fruit bars possessing the following requirements:

a. Suitable for consumption at temperatures as low as −70° F.
b. Possessing at least 6 months' storage life at 100° F.

PRESENT SITUATION. Eight combinations of dehydrated fruits in bar form were produced in quantity during World War II. The products were criticized as being dark in color and too similar in flavor. It was recently demonstrated that combinations of apples with apricots, and figs with raisins, dates, and citrus peel were very acceptable, but in bar form were difficult to bite at low temperatures. Reduction of bars to bite-size pieces eliminated the latter difficulty. Compressed fruit bars, composed of very low moisture dehydrated fruits in such combinations with higher moisture dried fruits as to result in bars with moisture content of less than 8 percent, have been produced on a laboratory scale. Completed tests, including accelerated storage studies, indicate they will be suitable for use in the lifeboat ration, and will meet stability requirement b.

Investigation of other types of fruits and combinations to furnish bars of greater variety and wider utility is continuing.

Information on acceptable, stable formulation of fruits or fruits in combination with small proportions of other food products would accelerate the solution of this problem.

FOOD FUMIGANTS

PROBLEM. Determination of whether the actions of ethylene oxide, propylene oxide, and ethyl formate on food constituents create toxic residues in fumigated foods and thereby render them objectionable for human consumption.

PRESENT SITUATION. Fumigation of dried fruit items to prevent insect and microbiological damage eliminates the need for heat pasteurization which tends to reduce their storage life. Ethylene oxide, propylene oxide, and ethyl formate have been used for food fumigants. The toxicity of the fumigants and their residual concentrations in foods under conditions of use are known. Direct toxic reactions from residues of the fumigants are improbable; however, very little is known regarding their actions on food constituents and the possible formation of toxic substances in a manner analogous to the toxicity arising from the agene process in flour. Information is needed on the effects of the fumigants on food constituents under conditions of application.

General Products Problems

Introduction

Considerable progress has been made during the past year, with the cooperation of industry, in solving many of the critical problems which confronted the General Products Division. Foremost among these has been the development of heat-stable and bloom-resistant chocolate bars and coatings. A specification that embodies these latest developments has been coordinated and published. Also included therein is a greater variety of coated candy bars which have all proved popular in recent procurement. New specifications have been issued for soluble coffee, soluble tea, Worcestershire sauce, imitation maple sirup, prepared sweetened coconut, soup and gravy base, and mincemeat—all of which are indicative of the scope and variety of work accomplished with the assistance of the Research and Development Associates. Although specifications have been written for these items, further work is necessary to improve specific factors. Soluble coffee, for example, has been proved to be very satisfactory as to flavor and body, but more improvement must be made in capturing the aroma of the fresh coffee and stabilizing it within the soluble coffee. A vigorous program with that as a goal is indicated. Work must continue on the improvement of the solubility of instant tea.

The most important of the remaining problems are as follows:

Beverage Program

SOLUBLE COFFEE

PROBLEM. Improvement of the aroma, and thereby the flavor, of soluble coffee.

PRESENT SITUATION. In operational rations, coffee is available only in the soluble form. The large quantities of soluble coffee used during the last war generally lacked the characteristic flavor and aroma of freshly brewed coffee. Considerable progress has been made in improving the flavor of soluble coffee, and better soluble coffees are now on the market, but there is still room for considerable improvement. More information and data on those properties that are capable of objective definition are needed in order that a specification for the highest quality soluble coffee may be written. In addition to specific analytical requirements, the present specification for soluble coffee provides for taste panel testing of bid samples according to a rather unique procedure developed by industry and the Institute.

Collaborative experimental work in plants, particularly with aroma stabilization and improved methods of extraction and drying, would be desirable. Samples of improved products accompanied by analytical data will be welcomed by the Institute for evaluation purposes.

COCOA

PROBLEM. Definition, for specification purposes, of the detailed chemical and physical constants of cocoa for use in cocoa beverage powder.

PRESENT SITUATION. Although cocoa purchases to date have generally resulted in the stocking of fair quality cocoa products for use by the Armed Forces, there is little consistency in flavor between suppliers which makes it necessary to strengthen the present specification with respect to this factor. The type and grade of beans, the degree of roast, and the limit on fat content are being investigated for their effect on acceptability. Recommendations for constructive revisions would be helpful in progressing the work.

IMITATION FRUIT BEVERAGES

PROBLEM. Development of acceptable and stable powdered beverage bases.

PRESENT SITUATION. While refrigerated or frozen liquid fruit beverage bases generally have the best flavor and highest acceptance they cannot be used under operational conditions where cold storage is not available. The use of dehydrated fruit solids in powdered beverage bases has been unsatisfactory because of their poor stability and their failure to impart a normal fruit flavor to the beverage. Therefore, it is considered desirable to develop a powdered beverage base from imitation fruit flavor, sugar, acid, and such other ingredients as may be necessary, that will be stable and easily reconstituted into a highly acceptable, palatable drink.

The Condiment Program

SOLUBLE SPICES

PROBLEM. Evaluation of soluble spices with respect to pure spice equivalent and standardization of objective chemical requirements.

PRESENT SITUATION. The standardization of soluble flavor extracts of spices is necessary before their use may be extended to ration items and the Kitchen Pack. Standardization depends on the development of objective and subjective requirements which, as in the case of black pepper flavoring, have demonstrated adequate control of the quality of such spice flavorings. Exploratory work is progressing towards the setting up of similar requirements for soluble sage flavoring. It is recognized that the criteria employed in standardizing each spice flavoring may vary according to the nature and the composition of the spice. The success experienced thus far in using a combination of subjective panel tests and analytical data to set up the specification requirements for black pepper flavoring makes such standardization of other spice flavorings feasible. The amount of time necessary to perform the subjective and objective testing of each spice flavoring may be appreciably shortened by the wholehearted cooperation and collaboration of industry and the Institute.

SOUP AND GRAVY BASE

PROBLEM. Determination of the effect of the use of various protein hydrolysates on the acceptability and stability of soup and gravy base.

PRESENT SITUATION. The present formula for soup and gravy base as outlined in Military Specification MIL-S-3271 makes a highly acceptable product. Since it may be made of protein hydrolysates from various sources and of various degrees of hydrolysis, certain difficulties of manufacture and formulation have arisen. The present product is quite hygroscopic when certain hydrolysates are used. This difficulty is being overcome by some members of the industry by reformulating their hydrolysates in order to yield the necessary free-flowing characteristics of the soup and gravy base. If it is to be used in all rations in place of bouillon powder, it must be free-flowing for easier packaging operations. We welcome the submission of additional samples of dry powdered hydrolysates that simulate the characteristics of soup and gravy base, accompanied by appropriate analytical data.

IMITATION BLACK PEPPER

PROBLEM. Development of

(1) An imitation black pepper which will be independent of the pure spice or its derivatives and which will consist entirely of domestic products.

(2) Development of an imitation black pepper which in part may consist of genuine black pepper or its derivatives. The product must approximate the pungency, aroma, and flavor of genuine black pepper and must have a storage life of at least 6 months at 100° F.

PRESENT SITUATION. The United States, which procures about 80 percent of the world's output of black pepper, is dependent completely on foreign countries for its supply. In the event of short supply, a suitable imitation black pepper should be available for use in products where the characteristics of black pepper are desired. Several entrepreneurs are carrying on imitation pepper work. Characterizing components of black pepper extractives are being isolated by several commercial and Governmental laboratories. It is believed that these components can be synthesized. To prepare a satisfactory specification, further information is required regarding materials of synthetic and natural origin to be used in formulating an imitation pepper.

Continued technical correspondence and liaison with interested laboratories and manufacturers of imitation black pepper will assure up-to-date information on developments in this field. The Institute will welcome the opportunity to evaluate submitted samples and will maintain a record of acceptable imitations which can be used. Acceptable imitation pepper made wholly of synthetics or extractives of materials available in the continental United States are desired.

SAUCES

PROBLEM. Formulation and development of specification requirements for condiment sauces in both liquid and dry forms.

PRESENT SITUATION. The experience gained through the preparation of the Military Specification for Worcestershire sauce, MIL-W-3492, and the subsequent procurements made thereunder will guide the formulation and the development of the specification requirements for barbecue and hot sauces. We hope to receive the same widespread industrial cooperation in the formulation, the submission of analytical data, and the development of objective test methods for these sauces as was received for Worcestershire sauce. The submission of improved formulations of samples of these sauces together with the pertinent analytical data will be welcomed. In addition, samples of dry or powdered Worcestershire, chili, barbecue and hot sauces that will reconstitute into acceptable sauces upon addition of water are desired.

Confectionery Program

IMPROVEMENT OF THE STABILITY OF NUTS, PEANUTS, AND COCONUT

PROBLEM. Development of methods and/or materials, such as antioxidants, that will improve the stability of nuts, peanuts, and coconut.

PRESENT SITUATION. Though nut and peanut bars are popular and highly acceptable they are not being recommended for procurement because of their limited stability. Coconut bars also tend to have a limited storage life. Information is desired from industry as to methods of increasing the stability of nuts, peanuts, and coconut especially when made into bars or discs for ration use. The submission of analytical data, experimental results, and samples incorporating ideas for improved stability would be appreciated as guidelines for our research program.

STABILITY OF ESSENTIAL OILS

PROBLEM. Improvement of the stability of essential oils by the use of antioxidants.

PRESENT SITUATION. Essential oils, particularly the citrus oils, tend to develop terpene-like off-flavors on extended storage. It is necessary to prevent or minimize this deterioration before the stability of the ration items in which they are used can be improved. The use of antioxidants such as butylated hydroxyanisole (BHA) or Nordihydroguairectic acid (NDGA) appears to be the logical means for attacking this problem. At the present time, collaborative storage stability tests with industry are under way on confections flavored with orange, lemon, and lime oils treated with butylated hydroxyanisole (BHA). It is desirable to collect experimental data on the effect of other antioxidants on the stability of essential oils. More data on the stability of the products in which the oils are used as a flavoring ingredient is most important.

Through contact with members of industry, valuable data have been accumulated as a guide for our research program, and it is hoped that others who have experimental data will cooperate with the Institute in solving this problem which is of great mutual interest.

COATED RATION BARS

PROBLEM. Improvement in the quality of bar coatings and centers, especially in flavor and plasticity of the coatings and the stability and texture of the centers.

PRESENT SITUATION. Within the past two years, through the use of certain emulsifiers and the substitution of higher melting-point vegetable fats for cocoa fat, a coating has been developed that does not leave a waxy residue in the mouth yet is stable at temperatures up to 120° F. The handling and manipulation of these coatings apparently requires certain modifications of the procedures normally used in "enrobing" bars in order to obtain best results. Further emphasis needs to be placed on the improvement of the flavor and plasticity of the new coatings.

Through use of the new type coatings and the addition of humecants, such as sorbitol, to the centers it has been possible to increase the storage life of coated bars such as fudge, caramel and nougat, and certain creams by several months through reduction in the hardening caused by drying out the centers. A problem that remains is that of increasing the variety of bars suitable for ration use, especially those containing nuts, peanuts, and coconut centers.

Spreads Program

PEANUT BUTTER

PROBLEM. Development of a stable (vitamin fortified) peanut butter.

PRESENT SITUATION. After six months storage at 100° F. samples of 23 peanut butters were examined chemically and by sensory means for the development of rancidity. No evidence of rancidity was found although there was definite oil separation and a loss in peanut flavor in some samples. It appears necessary to carry on further investigational work on the emulsion stabilizing characteristics of hydrogenated oils. The Institute has received excellent cooperation from industry, the Southern Regional Research Laboratory of the United States Department of Agriculture, and the Georgia Agricultural Experiment Station. Work is progressing towards a revision of the specification requirements for peanut butter. In general, the primary problems are to define the various degrees of "roast" and the various "grinds" simply and definitely; to determine the effect of the fineness of the grind on the tendency for oil separation; to determine the optimum amounts of hydrogenated peanut oil and salt to be used; to define "staleness" and "rancidity" simply and definitely; and to determine the specification requirements for the use of antioxidants.

CONTROL OF COLOR DETERIORATION IN FRUIT SPREADS

PROBLEM. Determination of essential factors affecting the deterioration of color in fruit spreads and development of methods for minimizing the off-color developments.

PRESENT SITUATION. Though the control of color deterioration in fruit spreads is a serious problem throughout the preserve industry, it is a much more serious problem in preserves that are procured for ration use since preserves are the only spreads available in certain rations. The problem is especially serious in the most popular and highly acceptable berry jams which show rapid deterioration and the development of unappetizing brown color when stored at temperatures above 70° F. At the present time the most practical approach appears to be the use of highly pigmented fruit in combination with fruit of lower pigment content. Several fundamental questions about the pigments present and possible means of inhibiting their deterioration, the relationship between browning reaction and pigment deterioration, and the effects of environmental conditions on changes in pigment deterioration need to be answered before the problem may be solved. At the present time effort needs to be concentrated on every possible means of handling, processing and storing the fruit and jams so as to minimize the color deterioration problems.

Desserts Program

INSTANT PUDDING POWDERS FOR RATION USE

PROBLEM. Development of acceptable and stable pudding powders which need only the addition of water for use in rations.

PRESENT SITUATION. There is a need to add variety to the desserts now available for ration use especially under operational conditions. The use of "instant type" starch pudding powders will be a means of providing additional variety if the problems of increasing the stability of the added milk solids, of developing improved flavors, and of increasing the dispersibility of the powder in water are solved. Several experimental and production samples from industry have been evaluated. It is hoped that this cooperative development work will continue and will result in the development of a product for which a specification can be written.

Container Problems

Introduction

The following are problems of concern to the Armed Forces which for their solution require the help of industry. It is realized that the problems in certain respects are of little interest to commercial manufacturers for domestic shipping practices. However, technologists in the container field, through their years of experience, may have suggestions or background information which could possibly be employed with some modification or change to meet military characteristics and requirements specified under each problem.

These problems are being worked on, of course, by technologists of the Container Laboratories staff. A few of the problems such as the ones on canned bread, containers for jam, and friction-plug closures, may within coming months be solved by studies under way in the Institute as well as outside, for example, projects undertaken by the can industry. Since the final solutions are pending, the problems have been included to invite suggestions that may lead to a permanent solution or to a better "interim" solution than now exists.

Container Testing

TEST METHODS FOR EVALUATING CONTAINERS

PROBLEM. Development of new testing procedures and/or modification of existing testing procedures for determining the suitability of containers for shipment, storage and handling at temperatures as low as —80° F.

PRESENT SITUATION. Standard testing procedures for determining durability of containers at room temperature and elevated temperatures (100° F. or higher) have been established by ASTM and TAPPI. Most of these methods are not applicable at temperatures below freezing. Many of the non-rigid containers currently available have failed field tests at temperatures of —80° F. It is necessary to adapt present test methods or develop new test methods which will enable laboratory personnel to determine why containers have failed and also measure the properties the containers must possess to perform satisfactorily.

Present methods of test evalution are not proving the values obtained by these methods, when production-run containers are subjected to field service conditions. Industry can be of assistance by suggested test methods which would more nearly simulate actual conditions.

TEST PROCEDURES FOR ROUGH HANDLING AND CYCLIC EXPOSURE

PROBLEM. Revision of rough-handling, quick-leak, and cyclic-exposure tests for Joint Army-Navy Specification JAN-P-116, "Packaging and Packing for Overseas Shipment, Preservation, Methods of" and Joint Army-Navy Specification JAN-P-131, "Barrier-Material Moisture-Vaporproof Flexible."

PRESENT SITUATION. The quick-leak, rough-handling, and cyclic-exposure tests stipulated in Joint Army-Navy Specification JAN-P-116 (Page 12, Par. F-3, F-4, Page 50, Par. 2-a, 2-b) contain no requirements for moisture content of atmosphere, are too severe for practical tests, and should be made consistent with test methods required in Joint Army-Navy Specification JAN-P-131.

Industry can assist in obtaining the needed requirements by providing comments as to the desired controlled humidities for Specifications JAN-P-116 and JAN-P-131 and suggested procedures to accomplish a more realistic and practical test.

General Supplies Clothing and Equipage

Introduction

Problems in this area of container research and development are as varied as are the supply items for which the division has the packaging and packing responsibility. In two areas, (1) the design of new or improved closures and (2) new or better case liners, the difficulties encountered have presented problems which in their solution will certainly involve problems of manufacturing feasibility. It is therefore desirable to project them before industrial groups who are interested in problems akin to those presented.

FRICTION PLUG CAN CLOSURE

PROBLEM. Development of

1. A tear closure similar to the key opening band, reclosure feature can.
2. Improved closure feature for multiple friction plug cans.

PRESENT SITUATION. At present all multiple friction plug cans for overseas shipment are being spot-soldered to the friction ring at three points equidistant from each other on the periphery of the plug. This method is not completely satisfactory for handling and shipping because plugs become disengaged in transit, spewing the contents throughout the container and adjacent cargo. Positive tear strip closures or expansion plug closures which will perform in the same manner as a round open-top hermetically sealed can are required. The industry is actively engaged in studying closures, but suggestions relating to this problem are invited. Continued research is imperative.

Case Liners

WATERPROOF CASE LINER FOR CLOTHING

PROBLEM. Development of waterproof case liner for clothing which will withstand rough-handling and exposure to temperatures ranging from —80° F. to + 160° F. and R. H. of 30 percent to 95 percent.

PRESENT SITUATION. The performance standards of existing commercial water-resistant barrier materials are limited; for example, in some instances, the water-resistant barrier materials have been developed to withstand temperatures up to 170° F. without bleeding, blocking or separation of the laminated plies of materials. However, at —20° F. they have failed, due to non-flexibility. On the other hand, materials fabricated with laminates which remain flexible at —20° F. or below have failed to perform in accordance with the standards required, due to bleeding, blocking, or separation of laminated plies at +100 F. and above. The required water-resistant case liner for clothing, in addition to meeting the above requirements, should withstand rough handling. If no case liners at all are used, exposure damage and water absorption will result. New types of materials have been submitted as possible solutions to this problem; some of these show definitely desirable qualities. The Container Laboratories are prepared to evaluate all materials submitted that may be pertinent to this need.

SEALED WATERPROOF CASE LINER FOR LEATHER PRODUCTS

PROBLEM. Development of a waterproof case liner which will permit the leather products to breathe, thereby preventing mold and degradation of the packaged contents. The case liner must be capable of being sealed to withstand rough-handling and cyclic-exposure tests at temperatures ranging from —80° F. to +160° F. and R. H. of 30 percent to 95 percent.

PRESENT SITUATION. Available types of waterproof barrier materials can be sealed, but experience and tests have indicated that the sealing of the case liner causes deterioration of the leather packed. For this reason, unsealed case liners are used. Closures are made by overlapping the seams approximately 2½ inches, thereby affording some water-shed protection from rain and other elements.

Any studies of this problem that may have been made by barrier material manufacturers would be of interest to the Institute staff concerned with this problem.

SEALED WATERPROOF CASE LINER FOR SOAP

PROBLEM. Development of a sealed waterproof case liner for soap (having a moisture content of 15 percent or greater) which will permit evaporation but prevent water absorption.

PRESENT SITUATION. Sealed case liners presently available do not permit evaporation and cause the soap to mold and become rancid. Unsealed case liners cause lumping as well as some exposure damage. If no case liners at all are used, exposure damage and water absorption will result. Results of any developmental work conducted on this problem would be of distinct interest to the Institute.

SEALED WATERPROOF CASE LINER FOR NAPHTHALENE FLAKES

PROBLEM. Development of a sealed waterproof case liner or barrel liner to preserve naphthalene flakes during shipment and storage at temperatures ranging from 0° F. to +160° F.

PRESENT SITUATION. Available materials for barrel liners and sealed case liners such as water-resistant laminates combined with asphaltum or wax blend laminates become tacky and bleed through the paper stock directly to the contents, thereby causing degradation. Unsealed case liners permit the entrance of water which also causes degradation of the product. Present types of waxed or unwaxed barrel liners permit the strength of the naphthalene to dissipate through pinholes inherent in the bag construction. The present method of packing in full removable head, 55-gallon, 18-gauge steel drums is satisfactory. Because of the shortage of such drums it is necessary to find a suitable alternate for overseas shipment. Information based on industrial study of this problem is desired.

FOOD TECHNOLOGICAL RESEARCH INS
LIBRARY

Subsistence Packaging And Packing

CANNED BREAD

PROBLEM. Prevention of corrosion on the interior of cans containing bread.

PRESENT SITUATION. Cans of bread taken from a commercial run were badly corroded on the interior. A 12 months storage test is being conducted at QMF&CI using (1) liners, (2) cans with interior of side seam coated and uncoated, and (3) various degrees of vacuum. Tests have not progressed to the point where definite conclusion can be drawn.

CONTAINER FOR JAM

PROBLEM. Development of a satisfactory container to contain one and one-half ounces of jam for use in operational rations.

PRESENT SITUATION. At present, two types of containers are in use, neither of which is entirely satisfactory. Both are metal cans. The tear tab often breaks, and a knife or sharp instrument is required to open the can. The second type of can, which has a circular score on the cover, can be opened either with the folding can opener supplied with the rations or by means of a knife or similar instrument. The sharp edge of the open can is a hazard. A proposed improvement is under study.

A container which can be more easily and safely opened is needed. Information as to a source of supply of an adequate container or as to the development of a new container is desired.

PROBLEMS in the NUTRITIONAL, ACCEPTANCE, and STABILITY PHASES of OPERATIONAL RATIONS

The problems that follow will be of special interest to workers in university, foundation, Government and other laboratories where work is being undertaken to determine the bases on which foods can be improved with respect to quality. Although many of these problems are general to the food field, they are intensified as military feeding problems owing to the special conditions under which rations are manufactured, shipped, stored, and eaten.

Further information on any of these problems may be obtained from the Quartermaster Food and Container Institute by addressing Dr. Harry Spector, chief, Nutrition Division, Mr. David Peryam, chief, Food Acceptance Division, or Dr. Carl Pederson, chief, Stability Division.

Nutrition Problems of the Armed Forces

Ration Evaluation

(A) ANIMAL FEEDING TESTS

PROBLEM. Development of methods for evaluating physiologically the nutritional adequacy of rations and ration items.

PRESENT SITUATION. It has been shown that while operational rations produce fairly good growth in rats a greater growth rate is observed when the rations are supplemented with proteins and vitamins. The results obtained serve as a warning that packaged rations which contain processed foods may be incomplete in nutrients despite being apparently adequate by calculated comparison with nutritional standards (N.R.C. and O.S.G. AR 40-250). It is important, therefore, to devise and conduct feeding tests with laboratory animals (rats, guinea pigs, chicks, dogs and monkeys) to provide information indicative of the physiological availability of the nutrients in packaged rations. Such studies will serve as a guide to possible nutritional inadequacies for the soldier.

(B) EFFECTS OF STORAGE

PROBLEM. To establish the nutrient stability and physiological availability of rations as consumed after varying periods of storage under known conditions of temperature and humidity.

PRESENT SITUATION. The extremes of storage temperatures and the long supply lines required by modern global warfare result in significant losses of nutritional value before the rations reach the fighting men in the field. The effects of storage under various known conditions of temperature and humidity on the nutritive value of rations must be determined.

(C) HUMAN FEEDING TESTS

PROBLEM. To ascertain the significance of feeding tests with laboratory animals for the nutritional welfare of members of the Armed Forces.

PRESENT SITUATION. Animal experimentation is a useful tool as a "pilot test" in providing guiding information on the nutritional adequacy of operational rations. However, due to qualitative, but particularly quantitative, species differences between laboratory animals and man in their nutritive requirements, information secured on animals is frequently inapplicable to man. Under stress conditions, the laboratory animal generally responds so differently in kind or degree, from the human as to render comparison difficult. Arrangements have been made for collaboration with the Quartermaster Climatic Research Laboratory for using enlisted personnel for evaluating the nutritional adequacy of operational rations and for studying the relationship of nutrition to climatic stress. To impart realism and vitality to laboratory investigations of combat rations field studies should also be conducted in collaboration with other National Military Establishment agencies.

Nutritive Value of Dehydrated Ration Items

PROBLEM. Determination of the nutritive value of dehydrated ration items.

PRESENT SITUATION. Increased emphasis given to the Quartermaster coordinated research and development program on dehydration stresses the need for obtaining information on the nutritive value of dehydrated fruits, vegetables, meats, and eggs. There is special interest in dehydrated commodity items because of the utility advantages such items afford for both military and civilian feeding in time of emergency. Dehydrated white potatoes already have a wide-scale use in the standard B rations. The scope of the dehydration program and the complexity of the factors that must be considered indicate the need for a coordinated attack by industry, U.S.D.A., research institutions and QMF&CI.

Vitamin Fortification

PROBLEM. To assure the presence in rations of adequate amounts of required vitamins at the time of consumption through ration item fortification.

PRESENT SITUATION. Considerable losses of vitamins A and C which are sensitive to oxidation and thiamine which is sensitive to heat, take place during processing and storage of ration items. In order to provide the recommended daily allowances of vitamins it is necessary to fortify operational ration items because they consist of processed foods and are subjected to storage, frequently at extreme temperatures.

Most of the rations are adequate in the amount of vitamin C provided only because of the presence of fortified beverage powders. Practically 100% of the ascorbic acid in the individual combat and trail rations is supplied in the form of these beverage powders. Since many soldiers do not drink coffee, tea or cocoa they cannot obtain an adequate amount of ascorbic acid unless other fortified carriers of this vitamin are provided in the ration.

Many ration items which have been tested as possible vitamin carriers are not being used because they have been found to be unstable, unacceptable, or have a limited utility. Special attention must be given to the development of stabilized forms of vitamins and/or substances which will promote the retention of vitamins added to ration items. The frequent substitutions and changes made in rations and ration components make it essential to establish a greater number and variety of stable and acceptable fortified carriers to furnish an adequate vitamin supply.

Vitamin Methods

PROBLEM. To develop and modify methods of assay for vitamins through independent and collaborative research in order to ensure valid and reliable research data on ration items.

PRESENT SITUATION. Due to numerous interfering substances developed during processing and high temperature storage of operational rations special problems are encountered in the assay of these rations for vitamins. Assay for ascorbic acid and thiamine are especially difficult because the methods used for these vitamins depend on the measurement of reducing ability and fluorescence, respectively.

Vitamin A is supplied in rations by a mixture of dairy products (animal vitamin A) and green and yellow vegetables (carotene), the latter contributing the greater proportion. Calculation of the total vitamin A content of rations involves the use of the conversion factor derived from the growth-promoting properties of pure beta-carotene when fed to vitamin A-depleted rats (0.6 gamma of beta-carotene = 1 USP unit of vitamin A). It has been demonstrated that the growth-promoting property of carotene from various food sources differs greatly from that of beta-carotene, depending on source. Furthermore, the nutritional status of the individual at the time of feeding and the composition of the diet have been shown to be important factors in the utilization and conversion of carotene into vitamin A. The use of a single conversion factor is, therefore, unreliable in estimating vitamin A activity.

The chromatographic method of assay for vitamin A precursors is based upon the separation of the biologically active carotenoid pigments (reported as beta-carotene) from the total carotenoid pigments. The beta-carotene content is responsible for the greater portion of the vitamin A activity of fruits and vegetables, but there are other precursors with varying vitamin A equivalents.

Collaborative assays with other interested agencies and correlation of chemical, physical, and microbiological methods of vitamin analysis with biological assay methods are required to insure reliable vitamin data for ration items.

Climatic Stress

PROBLEM. Provision of more complete information on (a) effects of climatic stress on nutrient requirements, and (b) effects of dietary modifications on tolerance to climatic stress.

PRESENT SITUATION. Critical analysis of the experimental and observational findings reported on the relationship of nutrition to climatic stress indicates the need for additional information on this subject. The problem of nutritional requirements of men under climatic stress is of particular importance to the Armed Forces, for such stress plays an important role in the efficiency, health, and morale of men exposed to such extremes of temperature as are encountered in the arctic or torrid zones, or to the hypoxia of high altitude.

Fundamental physiological information is needed concerning the effect of diet under conditions of climatic stress on those organs and systems of the body most intimately concerned with tolerance to climatic stress, because of their functions in regulating the heat economy, the body temperature and the transfer of oxygen from the atmosphere to the tissues.

Survival Food Packets

PROBLEM. To determine the physiological requirements of the nutritive essentials on reduced caloric and water intakes in order to provide the most adequate all-purpose survival ration which will meet the space and weight restrictions of all using military agencies.

PRESENT SITUATION. In military operations individuals are often cut off from food supply channels and must exist on limited amounts of food and water. Because of limitations on space and weight allowances in planes and ships a high carbohydrate food packet is the best interim solution to an all-purpose survival ration. While such a ration will support life for short periods of time it is not optimal. The goal we are striving for is a ration which will maintain the best possible state of physical well-being and enable the survivor to cope with his adverse environment until rescue takes place. Such a ration should enable him to recover more quickly and completely. With this objective in mind, special emphasis has been placed upon the feasibility of incorporating in the ration a suitable quantity of a protein, high in nutritional value, to spare and replenish body tissues. The inclusion of protein in the ration would be an aid to men suffering from injury, burns, loss of blood, or from shock. It would also improve palatability and acceptability of the ration, promote a sense of well-being, and increase the morale of the victims of disaster.

The chief stumbling block to incorporating protein in a survival ration has always been the classic physiologic concept that protein fed at low caloric levels would perforce be burned for energy. Since the nitrogenous end products of protein thus metabolized require additional urinary water for excretion, it would be both hazardous and uneconomical to feed protein when the intake of water is limited.

Schwimmer and McGavack have tentatively concluded from hospital studies of the nutritional requirements of men on reduced caloric intakes in a temperate climate that protein can be included in a survival ration without detrimental effect, even when the energy supply is only 900 calories and water is limited to 800 cc. They suggested a ration containing 900-1000 calories, 45-50 grams dried egg albumin, 30 percent hydrogenated fat by weight and the remainder carbohydrate.

Such a ration would be of value for a general survival ration, usable by all the branches of the Armed Forces. The logistical reasons which make it highly desirable to have an all-purpose survival ration to replace five such rations now in procurement were well brought out in the recent Survival Conference. It is important therefore to confirm and extend these studies to climatic extremes in order to obtain guiding information for the design and development of an emergency food packet capable of sustaining life and contributing to the retention of physical stamina and mental capabilities during a period of emergency survival regardless of geographic location or climatic conditions—i. e., an All-Purpose, All-Climatic, Global Survival Ration.

Acceptance Problems of the Armed Forces

Validity

PROBLEM. Determination of the validity of predictions of acceptability.

PRESENT SITUATION. Acceptance tests are predictions in that they imply estimates of the probable behavior of large groups of people from the responses of a few. This is obvious in field tests or in market surveys of consumer preference. It is true also in laboratory testing where intermediate criteria—such as expert judgment or simple preference—are substituted for the consumer response, for if these intermediate criteria are not themselves valid, research based on them is futile. Obtaining valid test results depends upon a number of factors such as the type of observers used, the conditions under which testing is done, the type of response called for in the test, controls used in the test, and normal experimental error related to sample size. It is seldom possible to maintain adequate control of all of these factors in the field and is never possible in the laboratory. Yet experience has shown that acceptance tests are more useful than such lack of control might suggest. For example, ration items developed on the basis of laboratory preference tests usually find good acceptance in the field. But also on record are many instances of failure of acceptance predictions.

There is a twofold need in this area. First, determination of the relative importance of the general factors that may influence the accuracy of predictions is required. This will permit more accurate interpretation of a test result in terms of the specific conditions of the test, and will prevent many faulty conclusions. Second, the accumulation of data from controlled experiments is needed to determine the degree of correspondence of results between the more important types of test situations, particularly between levels, such as laboratory preference tests and acceptance tests in the field. On the basis of such determinations, test methods and conditions for acceptance evaluation of food and ration items can be better selected.

Methodology

PROBLEM. Development and standardization of laboratory test methods for the following purposes:

(1) Measurement of consumer preference.

(2) Measurement of sensory differences.

(3) Analysis of flavor properties of foods.

(4) Determination of intensity of single flavor components within a complex flavor.

(5) Control of flavor and/or acceptability according to requirements in food specifications.

PRESENT SITUATION. Even though there is much interest among food technologists in acceptance and other types of sensory evaluation, there is as yet no standard and accepted methodology in the field. Each laboratory must devise its own methods to solve its specific problems. As a result there is much duplication of effort and inferior work is frequently accepted because of the lack of standards by which it may be judged. Variability among laboratories is so common that it is usually impossible to compare results from one laboratory to another. The lack of methods of proven adequacy is probably the major reason for this condition. It may be supposed that when such methods are available standardization will be relatively easy to achieve.

Early interest in this field arose among those whose basic scientific interests lay elsewhere than in human behavior. Consequently, there has been constant failure to recognize that the critical problems of sensory testing are primarily behavioral. Human behavior is the subject matter of psychology but the psychologists have been slow in accepting problems which involve the taste and odor senses. Experimental psychology has amassed much information that would be applicable here. However, it has not been used to any great extent because those who were faced with the problems of sensory testing have not been aware of the help they might get from experimental psychology and the psychologists have not been aware of the importance of the problems.

The general problem herein stated is vast and can only be solved through the labors of many people who accept common working principles, taking advantage of the contributions of psychology and making good use of statistical methods. Critique of procedures now available is uniformly necessary, followed by development work and the necessary, but too often neglected, final phase of testing for reliability and validity. The objective should be variation of method according to the purpose of the test, supplanting the present variation according to the experimenter.

Appetite

PROBLEM. Investigation of the appetite factor in acceptability, including:

(1) Determination of its effects on food preferences,
(2) Determination of its importance relative to other factors,
(3) Determination of the effects on appetite of exercise, ingestion of food, vitamin deficiency, emotional stress and other psychological and physiological factors,
(4) Development of methods of measuring appetite.

PRESENT SITUATION. That appetite is an important factor in determining eating behavior is an inescapable conclusion whether the observations upon which it is based are casual and personal or controlled and objective. Yet knowledge in this area remains inadequate. The direction of its general effects is common knowledge. Hungry people eat more readily and tend to be less critical toward food. But there has been little careful exposition of relationships between the variables concerned in the phenomena of appetite or of its status in the over-all problem of acceptance. Quantification of both its causes and effects has been almost completely lacking.

It has been reliably established through work done under the QMF&CI program that taste and odor sensitivity vary directly with hunger. Using this relationship as a starting point it should be possible to develop a laboratory method of measuring appetite although much remains to be done before a precise and useful method is achieved. However, this is a first step toward quantification and will facilitate exploration in the field.

Monotony

PROBLEM. Investigation of the role of monotony as a determining factor in food acceptance including:

(1) The delineation of the problem,
(2) Determination of the psychological basis for monotony,
(3) Determination of its importance relative to other factors affecting acceptance.

(4) Development of methods of measurement,
(5) Development of techniques for predicting its onset,
(6) Determination of possible relationship between monotony and nutritional adequacy of a diet.

PRESENT SITUATION. A poorly defined concept labeled "monotony" is used to explain certain phenomena of lowered acceptance that occur when there is lack of variation in a ration or when a single food is served too often. There is common agreement as to the existence of such phenomena and as to their genera deleterious effect. However, they have never been carefully investigated, either experimentally or by purely empirical methods Common knowledge, with all its possibilities of error, is at presen the only guide to control of monotony in design of rations and feeding programs. Hence the present situation in regard to the problem of monotony is not accurately set forth in the mere statement of that problem. Exploratory studies are required in order to specify more exactly the nature of the problem, followed by controlled experiments in the critical areas which are thereby located

Thirst

PROBLEM. Determination of the sensory basis of thirst, the influence of thirst on food acceptance behavior, and the influence of food on thirst behavior.

PRESENT SITUATION. Most of the considerable volume o work that has been done on thirst has related to the water balance of the organism, determining the internal and external conditions which will tend to make this balance favorable or unfavorable. In general, lowered water content of the body induces drinking behavior, including the thirst experience in man. Yet, there are significant contradictions in this generality. The subjective experience of thirst, which may do more harm than actual water deprivation, may be controllable independently of the water balance. Bu as yet, we are only beginning to learn where and how the stimul for thirst arise. Since such knowledge is basic, purposive attacks on other problems in regard to thirst behavior have not developed Our knowledge of control of thirst in terms of food, aside from studies of the effect of food on water balance, is purely empirical Basic studies are needed directed toward the end of discovering how rations can be adjusted for conditions of limited water intake in order to control subjective thirst as well as to maintain the physiological state of the individual.

Stress

PROBLEM. Investigation of food acceptance behavior under the types of psychological and physiological stress which may be expected in emergencies where adequate supplies of food and/or water are not available, and development of survival rations on the basis of this information.

PRESENT SITUATION. Designers of military rations are continually faced with the problem of providing food in some form to aid in the survival of men cut off by emergencies from normal sources of supply. Such rations must be convenient to carry and they must be chemically and physically stable since they may be stored for long periods before their use is required. Questions of acceptance pose a difficult problem in selecting the foods for such a ration. Though the exact circumstances under which these rations will be used cannot be known we are certain that the situations will contain elements of mental and, probably, physiological stress. It is difficult to get information from men who have been forced to use existing survival rations; it is perhaps even more difficult to interpret such information when it has been obtained. Although past experience is the best guide now available it has severe limitations. Information comes erratically and in insufficient quantity. Therefore, the design of survival rations must, in large part, be based on guesswork. For example, one important question which is as yet unanswered is whether the objective should be well-accepted items that will be eaten even by men who are emotionally disturbed, or relatively unattractive foods which may be eaten only to satisfy body needs.

Experimental work on food behavior under emotional stress has been confined to animals for the most part. Extension of such work to the human level is needed. Experimental attacks on problems that are specifically military are also required.

Sensory Physiology

PROBLEM. Determination of the mechanisms operating in gustatory and olfactory sensations and the relationships of these to the flavor complex.

PRESENT SITUATION. Those qualities of a food which tend to make it more or less acceptable are generally termed flavor, a concept which includes taste and odor, as well as texture, consistency, temperature, and perhaps other qualities. Of these, taste and odor are usually the most important in determining acceptability. Yet, acquisition of basic knowledge of these senses has not kept pace with discoveries in other areas of sensory physiology, such as vision and audition. We have no adequate classification of odors, no knowledge of the possible differentiation of the olfactory receptors nor even a very satisfactory theory, among those proposed, of the mode of action of the stimulus. Many problems also exist with regard to taste, although the latter is at a somewhat more advanced stage. Accumulation of basic information on gustation has begun but still has a long way to go. For both taste and odor we need the kind of information that may be gleaned from electrophysiological and neuroanatomical studies. Perhaps even more important from the standpoint of practical food acceptance work is the need for information about both absolute and difference thresholds of human subjects for various tastes and odors and how these measures are distributed in samples of consumer populations.

Food acceptance reasearch has, in addition, a need for knowledge of the functional interrelationship of taste and odor, as exemplified by such as yet unanswered questions as the two that follow:

Does stimulation of one sense alter the sensitivity of the other? Is the subjective quality of an odor or taste altered by concomitant stimulation of the other sense? There is also the problem of changes in the functions of the sensory organs with changes in the physiological state of the body. To date, only a few such effects have been studied.

The solution of many of the problems relating to thirst, appetite, and even those in methodology, will be more amenable to attack when we know more about the olfactory and gustatory organs and their modes of action.

Food Habits

PROBLEM. Determination of attitudes, preferences, prejudices, and other aspects of food habits with special reference to population groups significant to the Armed Forces.

PRESENT SITUATION. Anyone concerned with mass feeding is aware that the acceptance of a food is dependent upon a number of factors, of which quality of the food and other immediate causes constitute but one type. Other important determinants are found in the consumer himself. National, regional, and social influences impinge upon each individual and these interact with his personal food experiences to leave him with a set of more or less fixed food habits. Such habits and attitudes have great influence on what he will or will not eat.

Simple awareness of this situation is not enough. Lack of specific knowledge about the food habits of the consumer population handicaps the ration planner, for at present rations and menus must be designed on the basis of projections of incomplete information. If reliable data were available about food habits, attitudes, preferences, opinions, etc., feeding could be controlled in regard to this factor and would be more efficient and economical. Here military interest joins with that of food technology since the same problems continually arise in industry.

Required first is the development of adequate methods for measuring such variables; second, use of these methods to establish distributions of these variables within important segments of the American population.

A satisfactory initial approach to this work has been made through the completion of a questionnaire survey of food preferences among Army enlisted men. It covered all important recipes served in Army camps within the United States and utilized an Army-wide sample of respondents. Preferences for food combinations and desired frequency of serving of important foods are now being studied within the Army population. These are encouraging leads, but other methods should be tried and the studies should be extended to different civilian groups.

Food Stability Problems of th Armed Forces

The Accumulation of Information on th Stability of Processed Foods

PROBLEM. Collection of data on methods of analysis rel tive to the storage life of the many processed food produc

PRESENT SITUATION. The problem of stability or storage li of the many food products as affected by temperature, humidit type of container and method of packing is one that has attracte attention of food processors and scientists for years. Some studi have stressed the changes in quality of food as affected by chemic and enzyme activity; others have involved the changes due to micr biological activity whether or not they involve health hazard. Co siderable information has been obtained in the various laboratori throughout the country regarding deterioration of foods and man methods have been developed for evaluating such changes. Dat are being accumulated at the Institute on the various ration item Assistance will be appreciated in obtaining information relative t storage life of processed foods as well as methods of evaluation s that it may be assembled and correlated. Such information will b helpful in that it will serve as a guide and an aid in predicting st bility, in evaluating methods of analysis, in establishing specific tions, and in future studies relative to the various items for th Armed Forces.

Quality Evaluation Methods

PROBLEM. Development of chemical and physical methods for evaluating the quality of food items used in rations.

PRESENT SITUATION. Suitable methods for objectively determining quality of food commodities by chemical and physical measurements and predicting storage life from such data are lacking for many food products while in other instances the data have not been properly evaluated. In determining quality or degree of deterioration of many food products, we are dependent to a great extent upon sensory evaluation. These are valuable as indices of the present quality, but leave much to be desired for control and prediction purposes. They are also expensive and time-consuming. Although correlation of chemical and physical data with sensory evaluation is being made with the object of establishing chemical and physical measurements as quality indices, much more information is needed.

Laboratories with the necessary facilities for sensory evaluation, together with chemical and physical examination of food items, are urged to engage in such work. Information bearing on these relationships will be welcomed.

Deterioration Due to Discoloration

PROBLEM. Prevention of browning reaction in foods procured for use by the Armed Forces.

PRESENT SITUATION. Chemical reactions between proteins and carbohydrates, and their related entities, result in changes in food often referred to as the browning reaction. Such changes have been recognized in a number of foods. In some cases they cause deterioration of the food, but in other cases these reactions are induced to produce a desired change in a food. In general, these reactions are heat induced, but occur at ordinary storage temperature if sufficient time is given. Thus, the best method of control is low-temperature storage. This is impossible in handling many foods for the Armed Forces. Browning may be retarded by holding the moisture content at a low level, by use of reducing substances, such as sulfites, and by use of substances which may otherwise combine with or change the reactive chemical groups of the food. The latter process is now used in the new methods for preparing dehydrated egg. In many cases these methods of control are not understood or are impractical. Considerable work has been done on the basic mechanism of the browning reaction. Methods for preventing or inhibiting the deterioration in various food item should be developed by further investigation of the factors controlling the reactions.

The Quartermaster Corps would appreciate any information which might be made available regarding new approaches to solving o alleviating this problem.

Lipid Deterioration of Ration Items

PROBLEM. Stabilization of lipids of ration items.

PRESENT SITUATION. Deterioration of lipids is a major cause of loss of quality and acceptability of ration items. Lipid deterioration is known to result in "off" flavors, particularly in meat, dairy and poultry products. A degree of stability has been achieved through the use of gas packing, removal of accelerators, use of antioxidants, etc. Progress has also been made in studies relating to reaction mechanisms and to the role of specific lipid classes in deterioration. However, information at hand is inadequate to achieve the degree of stability required of Armed Forces rations under high temperatures for long periods of time. Improved methods for lipid stabilization based on more precise information of reaction mechanisms is a continuing need in order to apply preventive procedures more intelligently. Development of new and improved inhibitors and determination of the mechanisms of inhibition in order to properly utilize the inhibitors are necessary, and any new approaches that have been undertaken will be of interest to the Quartermaster Corps.

Effect of Processing and Storage on Protein Constituents of Food

PROBLEM. Determination of the effect on quality of protein changes occurring during food processing and storage.

PRESENT SITUATION. Processed food often lacks the desirable characteristics of the fresh product both as regards sensory and functional properties. These deficiencies may be ascribed to physical and chemical changes, or to both. Canned meats, dehydrated milk, and dehydrated eggs are some of the food products which have undesirable properties due to processing. Several of these changes are known to be due to alterations in proteins, but in many cases, as for example, canned meat, the role of protein changes responsible for undesirable flavor and texture is not definitely known.

Studies of the proteins of food commodities and determination of the changes they undergo during processing are essential in order to obtain information on which to base remedial measures.

Degradation Due to Enzymatic Action

PROBLEM. Determination of the role of enzymes in ration item deterioration.

PRESENT SITUATION. Enzyme action is known to result in degradation of constituents of foods such as proteins, lipids, etc. Enzyme activity will occur to some extent in all unheated foods, but in most cases enzymes are destroyed during food processing. In certain commodities, for example, hams and certain dehydrated foods, sterilization is not complete and deterioration may be due to enzyme activity. Similarly, milder sterilization procedures currently being investigated, such as sterilization by antibiotics and electronics, may not destroy bacterial enzymes which can bring about deterioration. The effect of electronic irradiation on various enzyme systems, for example, should be determined. The Quartermaster Corps would appreciate any current information which may be available.

Deterioration Due to Microbial Metabolic Products

PROBLEM. Determination of the influence of microbial metabolic products on food deterioration and methods of detecting such changes.

PRESENT SITUATION. The growth and activity of microorganisms in food before and during processing and storage may result in metabolic products, either toxic or non-toxic, whose presence results in deterioration and loss of quality in the food products. Degradation of fats and oils often results in rancid products and of carbohydrates in acid products. The nature of the metabolic products is usually unknown. Methods for identifying and characterizing the microorganisms causing the changes are tedious and time-consuming, but are essential to study the control of growth of the organisms. It is desirable to determine rapidly the identity of microorganisms involved in food spoilage, the character of the end products of growth, the factors involved in their formation, and the best methods of inhibiting the development of the microorganisms that cause food deterioration.

Inactivation of Microorganisms in Food Processing

PROBLEM. Collection of data on resistance of microorganisms to heat and to other inactivating methods for use in modifying processing procedures.

PRESENT SITUATION. The inactivation of vegetable cells and spores of microorganisms in food products by heat or other means is of practical importance to the entire food industry. Thermal processing must be severe enough to assure commercial sterility. Overprocessing results in loss of quality or shortened storage life of the food product. Considerable data on survival and on thermal death times of food spoilage and food borne pathogenic organisms are available, but more data are necessary. Much data are being accumulated on the effects of environmental factors. However, studies on the influence of environment and resistance are incomplete and inadequate. It has been known that resistance of microorganisms is affected by the characteristics of the basic food product itself and also by the substances that may be added to it, such as food acids, sugar, salts and similar substances. Recently, the possibility of the use of certain antibiotics and antimetabolites has been suggested. Information not in the literature at present that may bear upon this general subject will be welcomed by the Quartermaster Corps.

(Continued from inside front cover)

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A. H. Johnson, National Dairy Products Corporation
Raymond Powers, The Borden Company
R. J. Remaley, American Dry Milk Institute
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A. M. Swanson, University of Wisconsin

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E. A. Louder, Pet Milk Company
Bert Otting, Carnation Milk Company
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H. L. Rasmussen, Midland Cooperative Dairy Association
F. E. Rice, Evaporated Milk Association
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